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THE BIOLOGICAL LABORATORY AT COLD SPRING HARBOR[1]

By ROBERT CUSHMAN MURPHY
PRESIDENT, THE LONG ISLAND BIOLOGICAL ASSOCIATION

THROUGHOUT more than a half a century the Biological Laboratory has been fortunate in the character, even more than in the number, of its friends. These fall into two groups, one made up of men and women professionally devoted to scientific careers, who have studied, taught, attended the Symposia or conducted research at Cold Spring Harbor. Many of these maintain their membership in the association, even though they reside in educational communities scattered all over the United States or in foreign lands.

The second comprises neighbors (in the sense that they are chiefly Long Islanders), who represent public-spirited and enlightened sentiment in the area.

The two classes overlap, of course. Within a few weeks we have lost a distinguished man who belonged to both, and who for fifty years had been in many ways the first of our friends and builders, namely, Dr. Charles B. Davenport. You will remember also that his son-in-law, Dr. Reginald G. Harris, was director of the laboratory until his death, and that all other members of his family have been closely tied up with the growth of our institution. Many of you knew Dr. Davenport so well that no words of mine could enhance your appreciation. We have endeavored to crystallize our joint thoughts in a resolution which appeared in SCIENCE of March 10, 1944.

Nothing in human affairs is more satisfactory than a tradition of sound heads and large hearts. It is an inspiring experience to look back through the annual reports of many years and to read the names of the men and women of science and of national and world affairs who have given time, energy and judgment toward the advancement of our work. Happily, some of those from the early days are still working with us, and others, such as Mr. Russell C. Leffingwell, Mr.

[1] Address at a winter meeting of the members of the Long Island Biological Association, held at the residence of Mr. and Mrs. Russell C. Leffingwell in New York City, March 20, 1944.

Henry L. Stimson and Professor H. E. Walter, carry the badge of the old relationship through election to the post of director emeritus.

Dr. Demerec, director of the laboratory, has just given us a memorable account of its importance in relation to victory. If it had no other value than this essential one during a period of national crisis, it would justify all the work and other wealth that have ever been put into it. Because modern war involves not only armies but also everybody else—the helpless along with the combatants—it is no longer practical to count on "getting ready" when the blow falls. That is the way to defeat and to a lost cause. Rather, we have to "keep ready," and the existence of such an institution as ours, with its corps, its equipment and its status as a going concern, is an important item in that plan.

In fact, if we search for a single field in which our country has had an advantage over all its enemies, we find it in the number of thoroughly trained scientific minds of the highest quality, and in the sufficiency of tools by means of which the varied research of such minds is carried out. It would be impossible to overestimate the brilliance and diversity and effective organization that civilian science is contributing to the struggle in which we are all engaged. Without that concentrated skill and triumphant devotion to a common end, neither military nor industrial genius could have brought us as far along the road as we have come. It is safe to say that never in history has science been called upon for such a vast and coordinated piece of team-work within so short a period.

Happily, however, there is no need to point to war in order to justify our place in society. Peace is our true medium. We hope that when it spreads its light again we may never see the end of it. Our real program is a long-term affair; our aims lie in pure research rather than in fields that even border on industrial research. The practical applications come anyway, but the goal is simply truth. Science is in complete accord with at least one avowal of religion, namely that the truth will make us free. Last year, Dr. Demerec quoted in his report on research the following apt paragraph from the annual review by President Raymond B. Fosdick of the work of the Rockefeller Foundation:

> We must of necessity serve the war effort, for there is no future for what we most desire in a world dominated by fascism. But we have a responsibility equally compelling to preserve the treasures of the spirit which we hold in trust from the past for the benefit of the generations to come. There must be no broken link in the chain, no flaw in the title deeds by which what we most cherish is transferred to the future.

The restrictions of the present "gasolineless" times, which prevent our members from coming to the laboratory with their former freedom, fortunately coincide with the fact that we are not at the moment able to do justice to visitors. Much research of a highly confidential nature is in progress at Cold Spring Harbor. A temporary change of régime has been necessitated by the war. Even the "Symposia on Quantitative Biology," instituted by Dr. Harris in the summer of 1933, have had to terminate for the present. At least, they were not allowed to peter out. They ended in a blaze of glory in the Symposium on "The Relation of Hormones to Development," attended by 117 individuals, including representatives from Canada and from Chile, at the opposite ends of the Americas. When victory has been won, the Symposia will be resumed.

The ten published volumes of the Symposia are a noble scientific record. They are not light reading; as Mark Twain once said about something else, you might have difficulty in following the plots of some of the stories. They deal with such subjects as protein structure, bioelectric problems, radiation, growth and decay, the origin and functions of hormones, viruses, oxidation systems, the physics and chemistry of blood cells and the genes and chromosomes. They are evidence that now, as always in the past, the laboratory has kept in the forefront of significant biological trends.

If you want a sign of truly critical approval of recent activities of the laboratory, it is to be found in the attitude and actions of the foundations. They are proverbially hard-headed organizations, quite beyond favor or cajolement. Some of them list in their annual reports not only the pleas they have granted, but also the many worthy causes to which aid has had to be denied. Even to be listed among the unsuccessful applicants is an honorable estate! Lack of success by no means reduces them to the status of the candidate for a job in India, who cited as a high recommendation the fact that he had "failed entrance to Calcutta University."

But the foundations have not turned down the special needs of our laboratory. On the contrary, they have treated us through the years with conspicuous generosity. The Rockefeller Foundation, responsible for financing our Symposia, has recently joined with the Carnegie Corporation in enabling us to purchase on highly favorable terms a priceless parcel of land including the former residence of Mrs. Henry W. de Forest. This acquisition, now the home of our director and his family, together with the antecedent gift from Mrs. de Forest of the famous Sand Spit and of nine acres of harbor shore and upland, have enormously enriched the permanent outlook of the laboratory.

While speaking of the Carnegie relationship, which has been for many years so close that we make up practically one Cold Spring Harbor family, I may

remind you that it is the Carnegie Institution of Washington which lends us, by the year, the services of our director, Dr. Millislav Demerec.

My membership in the board of this association, which is a very great honor, is of only a few years' standing. But my relationship with the laboratory has grown to be an old story. I want for the moment to jump back nearly forty years in order to explain what the laboratory means to me, and what it does or may mean to many of the rest of us.

In the summer of 1907, the International Zoological Congress met for the first time in America. I was then spending a year at the American Museum of Natural History, before going to college, and I had the good fortune to be attached as a sort of aide-de-camp to several of the visiting scientific men from continental Europe. This gave me a profound feeling of importance, together with an opportunity to partake of all the free food and transportation provided for our guests. We invaded Cold Spring Harbor in force on what was the first visit for most of the foreign gentlemen as well as for myself, and proceeded to dispose of a gargantuan clam-bake. The occasion gave me visual proof of the valor of Englishmen, which has served them so well from the year 1066 to the present. It was demonstrated by the manner in which the professors from that country tackled steamed clams, corn on the cob, watermelon and various other products of this wild aboriginal land that they had never before seen. At the end of the orgy, the shells, shucks, husks and carapaces piled in front of each satiated man of science bulked about one cubic meter!

To cap the climax, one of the central European visitors joyfully announced that he had seen his first "Kolibri," by which he meant a ruby-throated hummingbird paying a visit to Mrs. Davenport's trumpet flowers.

The laboratory was a simple institution in those days, at least by comparison with the advantages we now possess. It had been founded seventeen years earlier, at a low economic ebb of the community following the end of the whaling era and of the manufacturing that once flourished in Cold Spring Harbor. Such subjects as invertebrate zoology had not yet given way to biophysics, genetics and experimental endocrinology, with all their formidable apparatus. Yet I can remember how greatly I was impressed by the prestige that the laboratory enjoyed among our noted visitors from all quarters of the globe. It is easy to understand this in retrospect because, even before that date, intensive studies of the life of the Sand Spit had carried the fame of Cold Spring Harbor into classrooms everywhere.

No doubt, moreover, much of the later work of the laboratory has made louder echoes at a distance than close to home. It is the same old handicap, affecting the rôle of the prophet in his own country. The laboratory has been supported mainly by a closely knit group of Long Island neighbors, yet its reputation may be greatest in San Francisco or London or Naples or Stockholm.

In the 1941 Annual Report, it was pointed out that our institution is only one year younger than the Marine Biological Laboratory at Woods Hole. A roster of the instructors, investigators and participants in scientific conferences at Cold Spring Harbor would include a large proportion of the outstanding American biologists of the past half century. Approximately 2,500 of them have received part of their training at our plant.

So, all in all, we have a lofty heritage. Who are they that will accept it and pass it along as a dynamic asset to succeeding generations? It is the future that should now claim our concern. While the war lasts, Mars—as always—will find means to keep his helpers going, but the god of war makes no provision for what follows.

Neither can we look to the foundations for our general needs, because their function is rather to nurture the infant idea and to carry it along until its bones harden, after which it must toddle on its own legs and prove that it is worthy to grow up.

Nor, in my opinion, does it profit us to think in terms of a great endowment. To-day there are serious doubts about the future adequacy of invested funds belonging to institutions thousands of times richer than we can ever hope to be.

No, it is as a membership body that this association is to sink or swim. We welcome our affiliates without reference to their geographic ties, but it seems to me that Long Island is our natural field, particularly as regards laymen. Surely there are enough potential friends in that area to carry the laboratory program superbly at imperceptible sacrifice. A thousand new small annual contributions would be worth more to us in the long run than a single gift representing the same total.

What we all hope to see on Long Island is a great burgeoning of proprietary interest in the laboratory, so that the residents of Smithtown, Greenport, Orient, Montauk, the Hamptons, Riverhead, Ronkonkoma, Islip and Cedarhurst—not forgetting Patchogue, Aquebogue, Nissiquogue, Cutchogue and just plain Quogue—may feel that it belongs to them no less than to the generous folk of the nearby communities who have proudly carried the standard through so many fruitful years.

DIET AND DISEASE IN THE BANTU

By CHRISTINE GILBERT and Dr. JOSEPH GILLMAN

DEPARTMENT OF ANATOMY, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, SOUTH AFRICA

THE incidence of disease in the Bantu (South African Negro) has long been known to be very different from that usually described for the Whites or Europeans in South Africa. Cirrhosis of the liver is found in four out of five autopsies performed on male Bantu at the Johannesburg General Hospital.[1] Gallstones and diabetes are rare diseases,[2, 3] while peptic ulcer in the rural Bantu population is almost unknown, but in a series of over 12,000 autopsies it was found to be seven times higher in the whites than in the urban Bantu.[4] Endocrine disorders affecting the pituitary and the thyroid are extremely rare, although colloid goiters are endemic in some areas of this country. Kidney stones in the Bantu are pathological curiosities.[5] Tuberculosis is extremely widespread and almost every second case admitted to hospital dies. Enlarged prostates are infrequent events, but sterility is not uncommon. The most remarkable discrepancy, however, is in the incidence of cancer. On the Witwatersrand Gold Mines, amongst the Bantu recruited from the native territories and Portuguese East Africa, primary carcinoma of the liver, a rare disease in Europeans, accounted for 90.5 per cent. of all cases of cancer. In the urban Bantu population, however, primary carcinoma of the liver was found almost exclusively in young male adults among whom it accounted for 31.9 per cent. of carcinoma of all organs, whereas cancer of the stomach was relatively common amongst males, especially after middle age. In the female, carcinoma of the genital system was responsible for almost 75 per cent. of cancers affecting all organs. Cancer of the stomach is unknown, but urinary bladder cancer is occasionally found.[6]

While it would be easy to attribute this peculiar incidence of disease in the Bantu to a racial factor, it seemed probable that the economic backwardness of the Bantu people might be an equally important factor which could not be overlooked. In 1936, 55 per cent. of wage-earners of all races, of which the Bantu constituted 90 per cent., earned between £9 and £36 (between $36 and $150) per annum. Only 4 per cent. of wage-earners had an income of $600 to $1,000 per annum.[7] In view of this meager wage, the Bantu people are constrained to live almost exclusively on the cheapest available carbohydrate—in this case—corn (maize or mealie meal). This food is partly cooked, and in some areas it is supplemented by fermented cow's milk. Meat is a luxury and is eaten only on ceremonial occasions or when their cattle or sheep die from disease or starvation.[8] It is a natural consequence that deficiency diseases of all kinds, including pellagra, are widespread amongst the black people in South Africa.

In order to ascertain with greater precision the effect of diet on the incidence of disease in the Bantu, it was felt to be of fundamental importance to discover the reactions of laboratory animals fed on corn pap and sour milk. For this purpose, 125 albino rats of the Lister strain and weighing between 40 and 55 gms were fed on liberal quantities of corn pap and fermented milk for a period of two years.

Careful records of the weights of the control rats, fed on a mixed diet, and of the experimental rats showed that at the end of three weeks the control animals had doubled their weights, whereas the experimental rats had not doubled their weights even at the end of seven weeks.[9] At the end of five months, apart from the retardation in growth, there were no gross external abnormalities, except that the coats of some animals assumed a pale rusty color. After 15 months, many rats had lost all their hair, especially in the lower abdomen and over the thighs and back. The majority developed a brown incrustation over the whiskers, around the eyes and the snout. Rats on a normal diet show by slit-lamp microscopy a clear cornea with glistening epithelium. Those on an abnormal diet have pathological lesions in the cornea which take the form of irregular blistered epithelium with evidence of scarring. The transparency of the cornea is further reduced by the ingrowth of capillaries which form a network in the corneal substance. Dental lesions were of frequent occurrence; this expressed itself chiefly in the form of irregular growth of the incisors, some of which grew either into the lower jaw or the top jaw. In one instance only did the incisors lose their orange-red color. In one rat, a hemorrhage occurred into the anterior chamber of the eye. In a few instances, the females gave birth to five or six young, but these were never reared.

[1] A. Sutherland Strachan, personal communication.
[2] C. F. Beyers, *Jour. Med. Asn. S. Afr.*, 1: 606, 1927.
[3] Joseph Gillman, *Am. Jour. Phys. Anthrop.*, 21: 131, 1936.
[4] P. C. Eagle and Joseph Gillman, *S. Afr. Jour. Med. Sci.*, 3: 1, 1938.
[5] V. Vermooten, personal communication.
[6] C. Berman, *S. Afr. Jour. Med. Sci.*, 1: 12, 1937; *ibid.*, 5: 54 and 92, 1940; *ibid.*, 6: 145, 1941.
[7] John Burger, "Black Man's Burden" (Gollancz, London), 1943.
[8] R. Smit, personal communication.
[9] C. Gilbert, J. Gillman, J. Mandelstan, T. Gillman and L. Golberg, *S. Afr. Jour. Med. Sci.*, 1943.

The organs most profoundly affected were the liver, lungs, testes and adrenals. Without exception, the animals developed liver lesions which varied from a marked fatty change to multi-lobular cirrhosis. Frank cirrhosis occurred in 20 per cent. of rats and affected almost exclusively the left lobes, while the right lobes underwent marked hypertrophy and were fatty. This liver damage in the rat was not without some interest in view of the high incidence of liver cirrhosis in the Bantu.

Lung lesions occurred in the majority of rats and they were chiefly lung abscesses and bronchiectasis.

The testes in all male rats were damaged to a greater or lesser extent. They were soft and, on section, oozed fluid. Giant cells were commonly found, and in one testis associated with complete tubular degeneration a nodule of interstitial cells had developed and, on cytological examination, appeared to be malignant. The prostate and seminal vesicles associated with the atrophic testes were reduced in size. It is worthy of note that the majority of Bantu patients suffering from cirrhosis of the liver had lost their sexual appetite.

The suprarenals presented a variable picture. In the majority of rats, the adrenals were enormously hypertrophied and in five instances adrenal hemorrhage was obviously the cause of death. Hemorrhage occurred only in the left adrenal. In the remaining animals, the adrenals were small and of a gray color.

The thyroid gland was atrophic while the parathyroids were invariably enlarged. The parotid gland and the pancreas did not escape injury. The parotid was always damaged, while the pancreas was affected in only 56 per cent. of cases. In the parotid there was no evidence of metaplasia, but the whole architecture of the gland was profoundly disturbed. The nuclei were extremely enlarged and showed cell degrees of anaplasia. Frequently a single cell contained 6 to 8 giant nuclei, each measuring in some instances as much as 40 microns. The lesion in the pancreas was different from that in the parotid. The granules disappeared from the acinar cells, and those later lost their spheroidal appearance and became arranged in the form of small dilated ducts. These aggregations of ducts were scattered throughout the pancreas and they could be seen with the naked eye as rather white opaque spots no larger than a pin's head.

Enlargement of the heart was found in those rats whose livers were severely damaged, and in two instances the endocardium of the enormously enlarged ventricles was found to be calcified throughout its extent. Cirrhosis of the liver was less common in females and dead embryos were not infrequently found in the uterus. It might be mentioned at this stage that although the skull was very thick, the bone cut easily.

It is thus seen that during the first nine weeks the feeding of corn pap alone leads to an arrest of growth, there being a gain of only 7 to 10 grams. While the addition of fermented milk definitely speeds up growth, it invariably causes the animal to develop extensive lesions, including a damaged liver. In young rats (40 to 50 gm) the livers begin to show fatty change at the end of 20 days, but these do not become very marked until the end of 150 days.

It was impossible to attribute the lesions in the rat to the absence of any specific vitamin. It is true that the testicular damage and the dead embryos in the uterus could be regarded as a manifestation of vitamin E deficiency, but it is very likely, too, that vitamin E deficiency would also be regarded as an expression of liver damage, since in dogs with biliary fistulae Brinkhous and Warner[10] have described the presence not only of muscular dystrophy simulating vitamin E deficiency, but also lesions which could be attributed to a deficiency of vitamins D and K. A damaged liver in the rat also apparently upsets the metabolism of fat-soluble vitamins, although there was no evidence of vitamin K deficiency. The occurrence of a malignant hyperplasia of the interstitial cells of the testes in the rat mentioned above is also of interest, since these tumors can be produced in mice by oestrogen.[11] It seems very likely that damage to the liver affects, amongst other things, not only the metabolism of some of the fat-soluble vitamins but also the metabolism of the steroid hormones. The work is proceeding to discover the factor or factors responsible for the various lesions in rats mentioned.

This simple experiment reveals the widespread lesions that may result from feeding the common Bantu diet to rats; it throws some light, too, on the problem of the high incidence of liver, lung and heart disease in the black people of South Africa; it also indicates that great caution must be exercised in attributing to a racial factor any differences in the incidence of disease amongst the black and white people.

OBITUARY

JAMES OTIS BEASLEY

THE South has lost one of its most valuable agricultural research workers, the nation one of its most promising young cytogeneticists in the passing of James Otis Beasley, who died on September 12, 1943, following wounds received in action in Italy.

Dr. Beasley was born at Wells, Texas, on September 7, 1909. He was educated in the public schools of Texas, graduating from Lufkin High School in

[10] K. M. Brinkhous and E. D. Warner, *Am. Jour. Path.*, 17: 81, 1941.

[11] C. K. Hooker and C. A. Pfeiffer, *Cancer Research*, 2: 759, 1942.

1928, from the Agricultural and Mechanical College of Texas in 1932 and receiving the master's degree from the same institution in 1934. During the next two years he served as an assistant in the Texas Agricultural Experiment Station, engaged in studies upon the morphology of the cotton seed. In 1936 he entered Harvard University as a graduate student, completing the requirements for the doctorate in 1939. During parts of 1938 and 1939 he was employed by the U. S. Department of Agriculture in genetic investigations of cotton at Raleigh, N. C. Since 1939, until he entered military service, he was agronomist and cytogeneticist on the staff of the Texas Agricultural Experiment Station. As a First Lieutenant in the Infantry Reserve he was called into active service on March 5, 1942. Feeling that he might be more useful in the Chemical Warfare Service he was, at his own request, transferred to that branch. He landed in Oran in May, 1943, took part in front-line action in the Sicilian campaign and again in the Salerno landing, where he was fatally wounded while leading a small detachment in an attack upon an enemy-held farm house in front of the American lines.

Dr. Beasley is survived by his wife, Dr. Elizabeth Wagner Beasley of Carroll, Ohio, whom he married in 1940, and by his son, John Wagner Beasley, born in 1942.

Since Beasley grew up in a rural community, in a state where cotton is the all-important crop, and since he was by nature a student, it is not surprising that he should have turned his energies at an early age to the study of cotton. As an undergraduate he competed for, and won, a traveling scholarship for the study of cotton, and during the summer of 1932 he visited the principal cotton-growing areas of the United States and the important cotton merchandising and manufacturing centers of Europe. When he entered Harvard as a graduate student, under Dr. E. M. East, he began almost immediately a study of the genetics and cytology of Gossypium species. In spite of the difficulties of growing cotton species in the vicinity of Boston, even in the greenhouse, he succeeded in making considerable progress in a relatively short time.

In his research Beasley showed marked originality not only in devising new methods of attack, but also in adapting the techniques of others to his own problems. By the use of mixed pollinations to prevent the bolls from shedding prematurely and by employing embryo culture techniques, he succeeded in producing species-hybrids not obtainable by ordinary methods. He was one of the first to utilize colchicine extensively in doubling the chromosome number of sterile hybrids to produce fertile allopolyploids. These he investigated cytologically to contribute to an understanding of the origin of cultivated cottons, a subject to which his more important published papers are devoted. He also utilized such hybrids in an attempt to transfer useful genes from wild 13-chromosome species to the 26-chromosome American cultivated cottons. His success at transforming sterile diploids to fertile tetraploids led him to suggest that hybrid vigor in such crops as maize might be perpetuated indefinitely by producing inversions and translocations with x-rays to the point where the F_1 hybrid of two strains should be sterile, then doubling the chromosome number to produce a fertile true-breeding tetraploid hybrid exhibiting the heterosis of the diploid. The proposal, which has never been adequately tested, offers important theoretical possibilities in plant breeding.

Dr. Beasley was an industrious, capable and conscientious scientist motivated by a friendly spirit of cooperation, an intelligent curiosity and an eagerness to contribute to the improvement of cotton and to Southern agriculture in general. For such a task he was superbly fitted both by temperament and training, for he combined to an exceptional degree an appreciation and understanding of the theoretical principles of genetics, with an ability to apply those principles to practical problems of plant improvement. It is difficult to imagine a man of Beasley's type, thoroughly peaceful, scholarly, quiet and reserved, taking kindly to the art of warfare. Yet he was successful as an officer; popular with his men and respected by the officers above him. He has been awarded the Purple Heart posthumously for "military merit" and has been recommended for an additional citation for "continuous devotion to duty." One can not believe, however, that the supreme sacrifice which he was called upon to make as a soldier can compare in effectiveness with the contributions to scientific progress and to human welfare which he almost certainly would have made had his peacetime pursuits been permitted to reach fruition.

P. C. MANGELSDORF

BOTANICAL MUSEUM,
HARVARD UNIVERSITY

DEATHS AND MEMORIALS

DR. DAYTON STONER, since 1932 state zoologist of New York, died on May 8 at the age of sixty years.

STUART BALLANTINE, since 1935 president of the Ballantine Laboratories at Boonton, N. J., known for his work in the field of radio engineering, died on May 7 at the age of forty-six years.

DR. WILLIAM SPENCER CARTER, from 1922 to 1934 dean of the medical faculty of the University of Texas, formerly associate director of the medical sciences of

the Rockefeller Foundation, died on May 12 at the age of seventy-five years.

DR. LOUIS LEROY, professor of the theory and practice of medicine at the University of Tennessee, died on May 9 at the age of sixty-nine years.

MEMORIAL HOSPITAL for the Treatment of Cancer and Allied Diseases, New York City, which is celebrating its sixtieth anniversary, is raising a fund of $150,000 as a tribute to the memory of the late Dr. James Ewing, who was associated with the hospital for thirty years both as president of the medical board and as director. Income from the fund will be used to support the undergraduate and graduate instruction for medical students at Cornell University Medical College and at the hospital, to finance at least two lectures annually on recent advances in neoplastic diseases and to support such special study as may seem advisable to the supervisory committee.

SCIENTIFIC EVENTS

THE INDIA COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH[1]

THE organization of industrial research in India, with a view to making her industrially self-sufficient, has been engaging the attention of the Government of India for some time. An Industrial Research Bureau had been established as a clearing house of industrial intelligence after the Sixth Industries Conference in 1934, but at the outbreak of war many sources of supply of finished products to India were either stopped entirely or much curtailed, and it became apparent that a central scientific and industrial research organization should be established immediately. Thus the Board of Scientific and Industrial Research was set up in April, 1940, for a period of two years in the first instance.

The functions of the board were to advise the Government as to the lines on which scientific and industrial research should be conducted, particularly as regards industries whose importance and possibilities were brought into the foreground by wartime conditions. The board was to utilize and coordinate the work of existing organizations and to make recommendations to the Government concerning the general lines on which industrial research should be pursued, and the specific problems which might be assigned to the technical staff directly under the control of the board, on the one hand, and to the various university and other scientific institutions on the other. The board consisted of four scientists, seven industrialists and one departmental head, with the executive council member in charge of the Commerce Department as chairman. It was to meet every three or four months. Research committees, composed of scientists and industrialists, were set up to examine and report on research schemes and watch their progress. Nineteen such committees were set up in the first two years.

When certain researches had reached a stage at which their commercial exploitation could be considered, an Industrial Research Utilization Committee was formed to settle the terms on which the researches could be released to manufacturers. The committee, consisting mostly of industrialists, was under the board and contained representatives of industries and of the Chamber of Commerce.

In 1942, the Council of Scientific and Industrial Research was constituted to coordinate and generally exercise administrative control over the Board of Scientific and Industrial Research and the Industrial Research Utilization Committee. Its fourteen members are drawn mostly from the board and the committee. The council has been established on a permanent basis and is financed by the Industrial Research Fund, providing in the first instance an annual grant of 10 lakhs of rupees (about £75,000 sterling) for five years.

Since its formation, the board has been mainly occupied with the solution of urgent war problems, but it has devoted considerable attention to the organization of scientific and industrial research on a scale commensurate with India's expanding needs. Plans have already been prepared for establishing a National Chemical Laboratory, a National Physical Laboratory, a Metallurgical Research Institute, a Central Glass and Silicates Research Institute and a Central Fuel Research Station. When these become effective, India will be provided with facilities for research reasonably adequate to meet her immediate requirements.

In order to give publicity to the research activities initiated by or undertaken at the instance of the board, it was decided to publish the *Journal of Scientific and Industrial Research*, the first number of which appeared in October, 1942. Publication is quarterly, and copies may be obtained on application to The Secretary, Council of Scientific and Industrial Research, New Delhi, India.

[1] From the *Journal of Scientific and Industrial Research*, Melbourne, Australia.

THE ESTABLISHMENT OF A DIVISION OF HIGH POLYMER PHYSICS IN THE AMERICAN PHYSICAL SOCIETY

DR. KARL K. DARROW, secretary of the American Physical Society, recently announced that a Division of High Polymer Physics had been authorized by the

council of the society, acting in response to a petition signed by thirty-one fellows and members.

The field of this division is defined as the advancement and diffusion of knowledge of the physics of high-polymeric materials such as rubbers, textiles and plastics. Meetings of the division may be held (if the council so authorizes) in conjunction with or separately from meetings of the society.

The council has appointed an "organizing committee" to take charge of the organization and the affairs of the division until by-laws are formulated and adopted by the council and a mechanism is set up for electing an executive committee. The organizing committee consists of F. G. Brickwedde, K. K. Darrow, G. B. Pegram and A. E. Ruark, selected from the council; and R. B. Barnes, W. F. Busse, P. Debye, J. H. Dillon, W. J. Lyons and L. A. Wood, selected from the members sponsoring the division. W. J. Lyons (Southern Regional Research Laboratory, 2100 Robert E. Lee Boulevard, New Orleans 19, La.) is serving as secretary of this committee.

According to Article IX of the constitution of the society:

1. The council may, upon petition by members of the society, form a division within the society charged with the advancement and diffusion of the knowledge of a specified subject or subjects in physics.

2. Each division shall elect an executive committee, the chairman of which shall report its activities and needs to the council.

3. Any division may be dissolved at the discretion of the council.

THE GEOLOGICAL SOCIETY OF MINNESOTA

THE Geological Society of Minnesota has just ended its most successful year. The society is unique in that most of its members are amateur geologists whose purpose is to study geology and mineralogy for their cultural value. It is an incorporated organization with approximately one hundred and sixty-five active members who, during the months from October to May, meet once a week for a lecture or talk on some geologic subject. The meetings are held in the Science Museum Auditorium of the Minneapolis Public Library. From May until October members endeavor to have a field trip every two weeks. During the year just closed there has been an average attendance of seventy-six members at the weekly lectures.

During each of the last two years a course of sixteen lectures, given by Professor George A. Thiel, of the department of geology of the University of Minnesota, has been sponsored. As a part of the program a bulletin entitled *The Minnesota Geologist*, with items of interest for members, is issued eight times a year.

The society consists of business and professional men and women interested in earth sciences. Officers of the society are Edward P. Burch, *Founder and Counselor;* Charles H. Preston, *President*, and Loretta E. Koppen, *Secretary*.

THE SOCIETY OF THE SIGMA XI

NEWLY elected officers of the Northwestern University Chapter of the Society of the Sigma Xi are: *President*, Professor W. F. Windle, of the School of Medicine; *Vice-president*, Professor F. A. Brown, Jr., of the department of zoology; *Secretary*, Professor Wallace Givens, of the department of mathematics; *Treasurer*, Dr. I. M. Klotz, of the department of chemistry, and *Member of the Nominating Committee*, Professor M. J. Herskovits, of the department of anthropology.

AT a recent meeting of the Rochester Chapter, the following new officers were elected: *President*, Professor R. W. Helmkamp; *Vice-president*, Dr. W. L. Bradford; *Secretary-Treasurer*, Dr. Charles D. Kochakian; *Member of the Executive Committee*, Professor Curt Stern; *Members of the Nominating Committee*, Dr. Harry Blair and Dr. Nolan Kaltreider. At the same meeting the late Professor-Emeritus Herman L. Fairchild, Professor-Emeritus Victor J. Chambers and Professor John R. Murlin were elected honorary members "in recognition of their meritorious service to the local chapter." The induction ceremonies were held on May 2.

THE annual meeting of the Tufts College Chapter was held on May 11. Following the initiation of newly elected members and associate members, the officers for the academic year 1944–1945 were installed: *President*, Dr. Paul A. Warren, biology; *President-elect*, Dr. David Rapport, medicine; *Vice-president*, Dr. Alvin H. Howell, electrical engineering; *Secretary*, Dr. Nils Y. Wessell, psychology; *Treasurer*, Dr. Herman R. Sweet, biology. The address of the evening was presented by Professor Kenneth Roeder, assistant professor of biology. He spoke on "The Physiology of Nerve Conduction."

A CHAPTER of the Society of the Sigma Xi was installed recently at Wayne University. The ceremonies were conducted by Dr. Harlow Shapley, president of the society, and Dr. George A. Baitsell, executive secretary. Dr. Shapley gave the installation address entitled "On Cooperation in Research." He also spoke later in the program on "Star Clusters." The officers of the chapter are as follows: *President*, William H. Pyle; *President-elect*, Arthur H. Smith; *Secretary*, Helen I. Miner; *Treasurer*, Ralph G. Janes, and *Member of Executive Committee*, Charles W. Creaser.

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT the annual meeting of the American Academy of Arts and Sciences, held on May 10 at its house at 28 Newbury Street, Boston, the election of thirty-nine

new fellows and four foreign honorary members was announced. The list of those elected in the sciences follows:

MATHEMATICAL AND PHYSICAL SCIENCES

Isadore Amdur, assistant professor of physical chemistry, Massachusetts Institute of Technology.

Arthur Robert von Hippel, associate professor of electrical engineering, Massachusetts Institute of Technology.

Ronold Wyeth Percival King, associate professor of physics, Harvard University.

Saunders MacLane, associate professor of mathematics, Harvard University.

Richard Martin Edler von Mises, lecturer on aerodynamics, Harvard University.

John von Neumann, professor of mathematics, Institute for Advanced Study, Princeton, N. J.

Linus Carl Pauling, professor of chemistry, California Institute of Technology, Pasadena.

Karl Terzaghi, lecturer on soil mechanics, Harvard University.

Edgar Bright Wilson, Jr., associate professor of chemistry, Harvard University.

NATURAL AND PHYSIOLOGICAL SCIENCES

Maxwell Finland, assistant professor of medicine, Harvard University.

Paul Rupert Gast, assistant professor of forestry, Harvard University.

Columbus O'Donnell Iselin, 2d, director of the Oceanographic Institution, Woods Hole.

Eugene Markley Landis, professor of physiology, Harvard University.

William Malamud, clinical director of the Worcester State Hospital, Massachusetts.

Hugh Miller Raup, assistant professor of plant ecology, Harvard University.

Albert Charles Smith, curator of the herbarium, Arnold Arboretum.

Harald Ulrik Sverdrup, director of the Scripps Institution, La Jolla, Calif.

George Widmer Thorn, physician-in-chief, Peter Bent Brigham Hospital, Boston.

Ezequiel Ordoñez, geologist, Mexico, D.F., was elected an honorary member.

The following officers were elected for the year 1944–1945:

President, Howard Mumford Jones.

Vice-presidents, George R. Harrison, Alfred C. Lane, Ralph E. Flanders, Fred N. Robinson.

Corresponding Secretary, Abbott Payson Usher.

Recording Secretary, Hudson Hoagland.

Treasurer, Horace S. Ford.

Librarian, Frederick H. Pratt.

Editor, Robert P. Blake.

SCIENTIFIC NOTES AND NEWS

DR. ERNEST W. GOODPASTURE, professor of pathology and associate dean of the School of Medicine of Vanderbilt University, was presented on May 9 at the fifty-eighth annual meeting, held in Atlantic City, of the Association of American Physicians, with the George M. Kober Medal in recognition of his work on viruses. The award is made annually to a member of the association "for outstanding contributions to the progress and achievements of preventive medicine."

THE Willard Gibbs Medal for outstanding work in chemistry of the Chicago Section of the American Chemical Society has been awarded to Dr. George Oliver Curme, Jr., of New York, director of research for the Carbide and Carbon Chemicals Corporation, "in recognition of his work in aliphatic chemistry." The medal will be presented at the coming meeting of the section.

THE Gold Medal of the American Institute of Chemists was presented on May 13 to Dr. Willard H. Dow, president of the Dow Chemical Company, "for his contribution to the war in the large-scale production of magnesium and styrene." At this meeting Dr. Gustav Egloff, research director of the Universal Oil Products Company, Chicago, who presided over the sessions, was reelected president of the institute.

DR. OLAF ANDREAS HOUGEN, professor of chemical engineering at the University of Wisconsin, was presented with the 1944 William H. Walker Award at the Cleveland meeting of the American Institute of Chemical Engineers in recognition of "outstanding contributions to chemical engineering literature." Dr. T. H. Chilton, of the du Pont Experimental Station, made the presentation.

PROFESSOR V. C. ILLING, professor of oil technology at the Imperial College of Science and Technology, London, has been awarded the Murchison Medal of the Geological Society, London.

THE Council of the Royal Society of Edinburgh has awarded the Keith Prize for 1941–43 to Professor James Ritchie, professor of natural history at the University of Edinburgh, "for his papers in the *Proceedings* of the society, in recognition of his distinguished contributions to natural history," and the Neill Prize for 1941–43 to Dr. Douglas A. Allan, director of the Liverpool Public Museums, for his papers published in the *Transactions* on "The Geology of the Highland Border Region."

PROFESSOR EVGENI PAVLOVSKY, of the Academy of Sciences of the U.S.S.R., since 1929 professor of zoology and comparative anatomy at the Military Medical Academy and lieutenant-general of the Soviet Medical Service, was awarded on the occasion of his sixtieth birthday the Order of Lenin "in recognition of his work in the field of parasitology."

THE degree of LL.D., *honoris causa,* will be conferred by the University of Aberdeen on Professor A. Findlay, president of the Royal Institute of Chemistry, and on Dr. V. M. Goldschmidt, professor of mineralogy and geology at Oslo.

DR. HUGH S. CUMMING, director of the Pan American Sanitary Bureau, was elected president of the fifth Pan American Conference of National Directors of Health, which met from April 22 to 29 in the Pan American Union in Washington. Vice-presidents elected were Dr. Manuel Baez, of Mexico; Dr. Eugenio Suarez, of Chile; Dr. Cesar Zuleta, of Peru; and Dr. Leopoldo Perez, of Ecuador. Dr. Aristides A. Moll was elected secretary-general.

THE officers of the American Institute of Nutrition for the coming year are Dr. Icie Macy Hoobler, *President;* Dr. Wm. C. Rose, *Vice-president;* Dr. Arthur H. Smith, *Secretary;* Dr. E. M. Nelson, *Treasurer,* and Drs. Geneviève Stearns, T. H. Jukes and C. A. Elvehjem, *Councilors.*

THE meeting on May 5 of the Section of Chemistry of the Ohio Academy of Science was presided over by Dr. H. J. Garber, assistant professor of chemical engineering of the University of Cincinnati. At this meeting Dr. Roy G. Bossert, of the department of chemistry of the Ohio Wesleyan University, was elected chairman for the coming year, and Dr. P. Rothemund was elected a member of the committee on membership.

AT the twenty-sixth annual business meeting of the American Society of Mammalogists, held in New York, the following officers were elected for 1944: *President,* E. Raymond Hall; *Vice-presidents,* E. A. Goldman and E. A. Preble; *Recording Secretary,* Seth B. Benson; *Corresponding Secretary,* Emmet T. Hooper; *Treasurer,* Viola S. Schantz; *Chairman of the Editorial Board,* William B. Davis; *Directors for 1943–45,* Victor H. Cahalane, William J. Hamilton, Jr., J. Eric Hill, Remington Kellogg and Otis Wade; *Directors for 1944–46,* R. M. Anderson, W. Reid Blair, William H. Burt, J. Kenneth Doutt and Claude W. Hibbard. H. E. Anthony was elected a trustee for the period from 1944 to 1947.

AT the annual meeting on May 5 of the New York Section of the American Chemical Society, Dr. Beverly L. Clarke, head of the analytical department of the Bell Telephone Laboratories, Inc., was elected chairman. He succeeds Professor Vincent du Vigneaud, head of the department of biochemistry of the Cornell University Medical College. Dr. R. A. Baker, head of the department of chemistry of the College of the City of New York, was made chairman-elect; Professor E. J. Durham, of New York University, was appointed secretary, and Dr. William W. Winship, manager of the American Division of Thermal Syndicate, Ltd., was elected treasurer. At this meeting Dr. Leonor Michaelis, of the Rockefeller Institute for Medical Research, gave an address on "Organic Molecular Compounds of the Quinhydrone Type."

THE title of emeritus has been conferred on Dr. Louis J. Curtman, of the College of the City of New York, with which he has been associated since 1907, becoming professor of chemistry in 1934.

DR. WALTER H. BROWN, chairman of the department of hygiene of the University of California at Berkeley, has been made acting dean of the newly established School of Public Health, for which an appropriation has been made by the State Assembly of California. Other schools and departments of the university, including medicine, medical research, education, nursing, home economics and sanitary engineering, will participate in its work. The name of the department of hygiene has been changed to the department of public health.

SIR JOHN FRASER, regius professor of clinical medicine of the University of Edinburgh, has been appointed principal of the university.

DR. HOMER L. SHANTZ, since 1936 chief of the Division of Wildlife Management of the U. S. Forest Service, previously for eight years president of the University of Arizona, retired early in April.

JAMES H. QUINN, chief preparator in the division of paleontology of the Chicago Natural History Museum, has left the museum to enlist in the Navy.

DR. CHRISTIAN A. RUCKMICK, who recently served as chief civilian psychologist in charge of mental testing at the U. S. Armed Forces Induction Station at Peoria, Ill., has been appointed supervisor of training on the staff of the Chicago and North Western Railway Company. He is in charge of a project which will ultimately involve the training of the thirty-two thousand employees of the railroad in cooperation with the Section of the Training within Industry of the War Manpower Commission. He is also serving as chairman of the committee on psychological techniques in the Organization of Techniques of the Office of Civilian Defense for the Metropolitan District of Chicago.

DR. FRED M. BULLARD, professor of geology and mineralogy at the University of Texas, will continue his studies on Parícutin this summer under a grant from the Geological Society of America. He will teach a course on the "Volcanoes of Mexico" in the Summer School of the National University of Mexico, in collaboration with Dr. Ezequiel Ordoñez, as a member of the faculty of the field school sponsored by the Institute of Latin American Studies of the University of Texas. Following the session he plans to spend approximately three months in a field study of Parícutin and related areas.

DR. ALBERT L. HENNE, professor of chemistry at the Ohio State University, an authority on fluorine compounds, is spending several weeks as research associate at the University of California at Los Angeles. While there he will deliver the William Conger Morgan Memorial Lecture, speaking on "Aliphatic Fluorides."

THE Messenger Lectures of Cornell University for 1943–44 were given during April by Dr. Griffith Taylor, professor of geography at the University of Toronto. The series of six lectures was entitled "Our Evolving Civilization."

DR. HOWARD T. KARSNER, professor of pathology at Western Reserve University, delivered on May 18 the first Frederick Robert Zeit Lecture sponsored by the Xi chapter of the Alpha Kappa Kappa Fraternity at the Medical School of Northwestern University. He spoke on "Hepatic Cirrhosis."

DR. R. R. SPENCER, chief of the National Cancer Institute, Bethesda, Md., delivered on May 3 the George Chase Christian Cancer Lecture at the Medical School of the University of Minnesota. The lecture was entitled "Biological Adjustment and Its Relation to the Carcinogenic Process." He also spoke on "Newer Techniques in Cancer Research" and on "The Public Stake in Cancer Research."

THE American Physical Society will meet at Rochester, N. Y., on June 23 and 24. The two hundred and sixty-second meeting will be held on July 22 at the University of California at Berkeley.

THE twentieth annual meeting of the West Virginia Academy of Science was held at Fairmont State Teachers College on May 5 and 6. While the program was somewhat smaller than usual there was an unusually large attendance considering the travel restrictions. The Division of Higher Education of the State Education Association was invited to hold its meeting with the academy and to participate in the program. Dr. Horace B. English, of the Ohio State University, gave the address at the annual banquet. He spoke on "Psychology in the Post-war World." The officers elected for the coming year are E. Meade McNeill, Athens, *President;* Hanibal A. Davis, Morgantown, *Vice-president;* Nelle Ammons, Morgantown, *Treasurer;* J. E. Judson, Buckhannon, *Secretary.* The next annual meeting will be held at Concord State Teachers College at Athens, W. Va.

RUTGERS UNIVERSITY has established a research council to promote research in all departments of the university. A survey is now being made of personnel and facilities to determine where new funds for research can best be invested. The council consists of nine members representing various fields of knowledge and colleges of the university. Dr. William H. Cole, since 1928 professor of physiology and biochemistry, has been appointed director of the council. He will serve in a staff relationship to deans, heads of departments and members of the faculty concerning research programs, and will represent the university in developing reciprocal arrangements with governmental, industrial, business and professional institutions outside the university. A special research fund has been placed at the disposal of the council and applications for grants for next year are now being considered.

DISCUSSION

THE OPERATIONAL VIEWPOINT IN HARDNESS MEASUREMENTS

THE appearance of a recent book[1] on the subject of hardness—the first, so the author says, to be written by a physicist—reopens an old question (actually it was never closed) which is of vital importance in the war effort as well as of general interest to science and industry.

The problem of hardness is distinctly a problem for the physicist, but the realm of physics must be understood to include such extensive fields as metallurgy, chemistry, x-rays, quantum theory and mathematics; and the subject of hardness is not only of interest to these but to a host of professions and industries ranging from the iron and steel industry to dentistry, and from ordnance to pottery. The importance of the concept needs no demonstration when one considers that the hardness of armor plate or shell tips might mean the difference between the survival or downfall of democracy and freedom.

In recent years the long existing confusion about hardness has been partially but not completely clari-

[1] "Hardness and Hardness Measurements," by Professor S. R. Williams, Amherst College. Published by American Society for Metals. 1942.

fied. Strangely enough, modern general physics texts say little or nothing about hardness, though in relation to touch it is one of our most common experiences in the physical world. Older physics texts usually listed hardness as one of the important properties of matter but went little further. A leading text of fifty years ago said, "Hardness is a property that can not be measured," and a popular dictionary says that "hardness is the quality or state of being hard." Neither of these statements is useful. The difficulty is that the word is not only asked to do double duty in the world of common experience and in the technical world, but it is also asked to do multiple duty in the technical world as all the various present-day hardness tests measure different sets of properties. The term "sets of properties" is used advisedly because a single type of hardness test such as the indentation of a steel surface with a diamond point may involve many properties such as compression, shear, slip, fracture, etc. To make matters bad, the relative amounts of these properties may vary as the test progresses. And to make matters still worse there is, as Williams himself has said, no known method of hardness testing (even magnetic methods) which do not change the hardness of the sample as the test progresses either by cold working, magnetic working, etc. This reminds one of quantum measurements in the remote atomic realms in which the act of measuring defeats the object of the measurement. Such defeatism may be a characteristic of all measurements pushed to an extreme, but here one faces the problem in the realm of everyday practical measurements.

New tests for hardness are continually being invented, and many comparisons of the results of different tests have been made, but the problem can not be satisfactorily solved until the test elements are reduced to utmost simplicity and clearly defined. From such a viewpoint it appears that the problem of hardness is one in which the recognition of the value of the operational viewpoint is particularly desirable. Just as in the case of velocity and other apparently simple concepts, the concept of hardness can have no real meaning aside from the operations which have been performed. The operations performed here, however, are much more complicated than those of reading a clock and a scale of length to get a velocity, even though we recognize the relativistic complications in the concept of velocity. But here, though the operator may only turn a wheel or release a lever, the testing machine is itself performing a set of complicated operations. Take, for instance, indentation by a diamond point and consider the many elements as indicated above into which the apparently simple operations can be resolved. This manifold of operations must be understood if the measurement is to have meaning in terms of them. This is exactly the standpoint taken by Professor Williams, who without actually using the term operational viewpoint has spent many years prying into the multiplicity of operations which go to make up a particular hardness test. But the field is so large and the types of training which are needed are so varied in even apparently simple investigations, as the author has shown, that there is plenty of work for the future. Some idea of the amount of work already done can be obtained from the bibliography of approximately 2,000 references in Professor Williams' book.

The confusion in the past over the question of hardness has been largely due not only to the large variety of methods of testing hardness but especially to the conflicting viewpoints of metallurgists, physicists and others who are only now being drawn together by a clearer recognition of the fundamental principles involved. For instance, one example of a radically different viewpoint from that outlined above is the work of D. Landau, who by a method of dimensional analysis has arrived at a formula for hardness $H = CE^m L^n$ where H is a numerical measure of hardness; C is a constant; E is the modulus of elasticity; L is the compression elastic limit, and m and n are small positive numbers. Such a procedure may imply the existence of an absolute standard or it may set up an arbitrary standard which the formula approximates. But it implies that we know much more about the dimensions involved than we actually do and it neglects the operations on which a knowledge of such dimensions is based and which vary from one experimental procedure to another. Neither would the operations involved be easy to apply to a series of samples.

If workers in the field will recognize the fundamental character of the operational viewpoint a considerable forward step would be taken toward a common meeting ground for those workers of diverse interests, and widely different types of training whose views in the past have often seemed irreconcilable. But to further such a position it will be necessary to do much more experimental work in clarifying and defining the operations involved, excellent though the beginning already made may be.

ROGERS D. RUSK

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THE POSSIBILITY OF PREVENTION OF TUBERCULOSIS BY NON-POISONOUS CHEMICAL AIR DISINFECTION AND BY KILLED VACCINES

OF all diseases tuberculosis is one of the most common and also costly to handle, since it is relatively refractory to all known methods of treatment, except prolonged rest in bed. The great desirability of preventing this infection is therefore obvious, but meth-

ods of accomplishing this purpose are too few and for some time but few advances in method have been obtained along the lines recently pursued. One conspicuous advance was the determination of the lethal action of ultra-violet light on tubercle bacilli, *in vitro*[1] and in air.[2] Good diagnosis also has been obtained and this has made possible a policy of detection and slaughter of infected livestock, and a parallel policy of detection and segregation of infected humans. The perfect fulfilment of these policies would doubtless be quite effective, but is severely hampered in various parts of the world by the tremendous cost of execution. This country alone has roughly two million[3] tuberculous humans, and in comparison with other countries our own is an island of safety. In recent years, as frequently pointed out in your columns,[4] a group of scientists at this university have given us a brilliant new lead: Chemical air disinfection in closed spaces. With respect to tuberculosis this lead has remained undeveloped.

I have recently determined, by guinea pig test, the fact that tubercle bacilli (Ravenel bovine-type), in fine suspensions at 70° F are rapidly killed by immersion and agitation in propylene or triethylene glycol of 60, 70, 80 or 90 per cent. strengths. Of 82 guinea pigs subcutaneously inoculated with tubercle bacilli subjected to such treatments for 3-, 5-, 10- or 15-minute periods, not one animal showed as large and numerous lesions as control animals, at the site of injection, regional and iliac lymph nodes, spleen, liver and lungs. Rapid and extensive destruction of pathogenicity invariably occurred. In 80 per cent. propylene glycol this destruction was complete within 5 minutes and in triethylene glycol within 15 minutes. Even in lesser concentrations death was often complete within 15 minutes. Minor irregularities in the outcome may have been due to variations in the size of bacillary aggregates in various tests.

Since the glycols, as vapors, are infallibly attracted to moist dust in the air, and kill almost all non-spore-bearing bacteria[5] if suspended in properly humid air, it is difficult to escape the conviction that a useful degree of chemical air disinfection of tubercle bacilli might be worked out by a sustained attack. Killing *in vitro*, however, is slower than that reported for some other pathogens.[6] Also, the practical success of the scheme will, at best, depend upon actual maintenance of effective glycol vapor concentrations in the vicinity of infectious bacilli. The rapid mastery of numerous difficult problems, both experimental and engineering in nature, merits, in my opinion, the allocation of large funds. The inspiration for this attack must be obvious to all bacteriologists, but the originators of the method are fully engaged on other problems, and for this reason any inquiries should be directed to myself.

Incidentally the possibility of an anti-tuberculosis vaccine of bacilli suspended in a glycol seems worth examination. Such a vaccine, if found effective, would have the advantages accruing from permanent freedom from contamination, low temperature killing, high dispersion and consequent relative ease of absorption in tissues, etc. This subject derives enhanced importance (a) from the frequent inacceptability or unavailability of living vaccines, such as BCG; (b) the enormous, rapidly approaching need in the post-war world; (c) the rather tardy appreciation of moderate degrees of immunity, by the rabbit protection test;[7] and (d) the consideration that protection against only the first of a series of minute subfatal infecting doses might often decide the whole outcome: Most investigators now accept the proposition that complete conquest of a primary infection imparts a moderately enhanced resistance, at least as great as that conferred by BCG.[3]

The similarity in structure between the glycols and glycerol,[8] a normal metabolite of many organisms, enlarges the horizon for "fooling" our pathogens.

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[1] E. Mayer and M. Dworski, *Am. Rev. Tuber.*, 26: 105, 1932.

[2] W. Wells and M. Lurie, *Am. Jour. Hyg.*, 34: (Sect. B) 21, 1941.

[3] R. G. Bloch *et al.*, *Am. Rev. Tuber.*, 37: 174, 1938 and *Am. Jour. Roent. and Rad. Ther.*, 49: 463, 1943.

[4] O. H. Robertson *et al.*, SCIENCE, 97: 51, 1942, and 495, 1943; 98: 479, 1943. Also *Jour. Exp. Med.*, 78: 387, 1943.

[5] Just as the sulfa drugs may help to cure tuberculosis by quelling secondary invaders, the glycols may become indispensable treatment in sanatoria, for attacking these agents while still in the air.

[6] Killing in air is being subjected to provisional tests. Bacilli in sputum droplets will obviously be in a different state of aggregation than the warty, coherent colonies somewhat incompletely broken up here. A thin film of mucus on air-borne bacteria has been found by Robertson to be favorable to their killing by glycols; the mucus presumably retains moisture, and therefore traps glycol.

[7] T. S. Potter, *Proc. Soc. Exp. Biol. and Med.*, 54: 145, 1943; *Jour. Am. Med. Asn.*, 124: 527, 1944. E. Opie *et al.*, *Jour. Exp. Med.*, 66: 761, 1937; *Am. Jour. Hyg.*, 29: (Sect. B) 155, 1939.

[8] C. H. Boissevain, *Proc. Soc. Exp. Biol. and Med.*, 54: 342, 1943. As to the penetrating power of glycols for bacteria, see also T. G. Randolph and R. F. Mikell, *Am. Rev. Tuber.*, 49: 109, 1944.

SALMONELLA ISOLATED FROM HUMAN MESENTERIC LYMPH NODES

STUDIES have been made investigating Salmonella from pig's mesenteric lymph nodes, the papers of Hormaeche and Salsamendi,[1,2] Rubin,[3] Edwards, Brunner and Rubin[4] and Varela and Zozaya,[5] all

[1] *Arch. Urug. Med. Cir. Esp.*, 9: 665, 1936.

[2] *Ibid.*, 19: 375, 1939.

[3] *Jour. Bact.*, 40: 463, 1940.

[4] *Proc. Soc. Exp. Biol. and Med.*, 44: 395, 1940.

[5] *Rev. Inst. Salub. Enf. Trop.*, 2: 311, 1941.

these investigators identified various species of Salmonella. The present publication reports the results of an investigation of Salmonella cultured from the mesenteric lymph nodes of 171 persons dying of different maladies in the General Hospital of Mexico. D.F.

The technique employed in this study was the same as that utilized previously in our study of Salmonella obtained from pigs.[5]

We isolated four species of Salmonella of Group B, five species of Group C and one species of the Further Groups. Twenty-seven Salmonella were identified: *S. typhimurium* 5 times, *S. oranienburg* 6, *S. newport* 4, *S. muenchen* 4, *S. montevideo* 3, *S. reading* 1, *S. essen* 1, *S. chester* 1, *S. choleraesuis* 1 *and S. carrau* 1.

GERARDO VARELA
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SCIENTIFIC BOOKS

SINANTHROPUS PEKINENSIS

The Skull of Sinanthropus Pekinensis: A comparative Study on a Primitive Hominid Skull. FRANZ WEIDENREICH. *Paleontologia Sinica,* New Series D. No. 10, Whole Series No. 110. Published by the Geological Survey of China, 1943. New York. N. Y.: G. E. Stechert and Company. 278 pages of text. 38 tables. 93 plates. Index and Bibliography.

THIS massive and cumulative study of the human remains found near Peking is without doubt the most significant and important treatment of the whole subject of fossil man to appear in many decades. Perhaps indeed, because of its wealth of new information, it is the most significant comparative study yet to be made in the entire field of human paleontology. That the work has been brought forth in the midst of war, at a time when even the whereabouts of many of these precious fossils is unknown, is a tribute to American democracy and to the single-hearted devotion to science of Franz Weidenreich.

A pupil of the late Gustaf Schwalbe, whose broad interests ranged over many fields of biology, Dr. Weidenreich has been the carrier of a great tradition in a day when narrow specialization has too often impeded the course of science. That there are men in our universities who know his name as a histologist and not as a paleontologist, that anthropologists are often unaware of his contributions in other fields than their own, is both indicative of the breadth of his interests and the increasingly divergent paths of the anatomical sciences. It has been exactly forty years since Dr. Weidenreich wrote his first paper upon the development of the human chin, begun, characteristically, when he was actively engaged upon the study of the blood and its related organs. The present work is the product of decades of wide labor in seemingly remote fields, all of which have contributed to the scholarship brought finally into splendid focus in the writing of this volume.

The book begins with an account of the discoveries at Choukoutien, their state of preservation and an explanation of the methods employed in their restoration. Part II is devoted to an analysis both of the structural features of the crania in general, and the characters of the individual bones. The metrical as well as the morphological features receive detailed attention. Variations, both sexual and individual, are noted and the character of the *Sinanthropus* skull thoroughly established. Needless to say, its right to a position in the human phylogeny distinct from that of the Neanderthal type is thoroughly demonstrated. Part III of the monograph is devoted to a comparison of the Peking material with other fossil types such as *Homo soloensis, Pithecanthropus, Africanthropus,* the Australopithecines and other more recently discovered remains. Not content with his exhaustive treatment of *Sinanthropus,* Dr. Weidenreich details many new and pertinent observations upon these latter forms, as well. In conclusion, he ventures extended general comment upon the course of human evolution in the light of the evidence available to our generation.

The salient characters of *Sinanthropus* may be indicated in compressed form as follows: A completely erect posture, associated with a skull and face still in the grip of active evolution from an anthropoid to a human state. The skull is dolichocephalic averaging at 72.2. The great thickness of the cranial vault is a marked element in the low cranial capacity, which ranges from 915 cc to 1,225 cc with an average, for five skulls, of 1,043 cc. The supra-orbital ridges are massive and protrude beyond the infra-orbital border. The marked post-orbital constriction and small size of the brain case combine to produce a markedly phaenozygous skull. The nasal bridge is broad and short, the anterior nares wide and low. There is no nasal spine. The torus occipitalis "appears as a continuous broad bulge . . . which crosses the occipital bone in its entire breadth. . . . " The breadth of the skull is greatest at the biauricular plane, and, unlike the condition in modern man, decreases above that level. The skull is low and there is a pronounced sagittal crest

or ridge. After a careful consideration of the problem of suture-closure, Dr. Weidenreich records the suspicion that growth and aging took a more accelerated course in *Sinanthropus* than in *Homo sapiens*. Sexual distinctions in size may have been a little more pronounced than in modern populations.

The species is viewed as lying on the direct line of ascent to modern man, with certain characters suggesting Mongoloid affinities. Dr. Weidenreich does not share the rather widely held view that the modern races are relatively recent variants from a generalized *sapiens* stock. Instead, he regards present human varieties as the product of already existing racial variations among the earlier hominids.

Taking exception to the views of Gregory and Hellman that *Dryopithecus* represents the stock from which both the human and anthropoid branches were derived, Weidenreich expresses the belief that the dentition of *Dryopithecus* and related forms betray specializations already suggestive of the anthropoid rather than the human line. Just as seriously, he has considered and rejected his own earlier views upon *Homo soloensis*. On the basis of more extended information, he now regards this form not as an Asiatic Neanderthal, but as an even more primitive variety lying in an intermediate position between the Pithecanthropus and Neanderthal stages.

Dismissing *Eoanthropus* as an "artificial combination of fragments," Dr. Weidenreich feels that our accumulated remains are now sufficient to establish a reasonably clear line of ascent to modern man. Furthermore, he regards this line as unbroken by extreme saltatory variations. The existence of more advanced forms, anatomically, in early geological periods which also reveal the presence of more primitive hominids, is explained on the basis of retardation in some areas, more rapid advance in others. Thus the living Australian he would regard, not as an archaic Pleistocene survival, but young in the sense that he has more recently attained a status through which the more phylogenetically advanced types have already passed. It remains to be seen whether the recently reported Keilor skulls suggesting, according to reports,[1] great antiquity for the Australoid stock, will force a reconsideration of this view.

Obviously some of Dr. Weidenreich's opinions will be challenged. The theory expressed above, for example, is capable of political distortion and has social implications which will not be well received in some quarters. To say this, however, does not prove Dr. Weidenreich's theory to be wrong, and certainly he offers it objectively, with no thought of stimulating racial disparagement. In seeking for an explanation of undoubted discrepancies between anatomical status and the geological age of more or less simultaneously existing Pleistocene forms, Dr. Weidenreich has fallen back inevitably upon an explanation, which, if true, might by indirection be taken to imply racial "childhood" for certain existing peoples. The mental implications of this view are not discussed, but they are too iconoclastic from the standpoint of the sociologist to be ignored.

The possibility of inequalities in the speed of development of various human types will be certain to add fuel to the controversy over racial superiority. Without attempting to assay the argument here, let it be pointed out that Dr. Weidenreich himself slyly comments that the European *sapiens*, on the basis of geological evidence, "must either be older or its later development must have been somehow more retarded than is the case with the Southeast Asiatic line. . . ." This good-humored remark should, I think, prove ample protection from charges of partiality toward the European branch of mankind.

Irrespective of some of the author's more tentative ventures into the unknown, the amount of anatomical detail available in the compass of this single volume makes it a priceless acquisition for the paleontologist and comparative anatomist. The book is more than a study of *Sinanthropus*. It is a vast and painstaking review of the whole subject of human evolution enlivened by an extremely thorough and original mind.

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REPORTS

WARTIME INVESTIGATIONS AT THE MELLON INSTITUTE. II

SCIENCE SERVES SYNTHETIC RUBBER

The production, purification and analysis of butadiene and styrene have been investigated searchingly by the multiple industrial fellowship on tar synthetics, and the fruitful results have been put in industrial practice at Kobuta, Pa. No success here has had a stronger spur and the rapid and very beneficial outcome demonstrates how war stimulates excellence in research. Studies have eventuated in specifications for metals most suitable for butadiene and styrene plant construction. Worthy fundamental work has been done on the physical chemistry of the purification of synthetic rubber raw materials. The polymerization phenomena of butadiene, styrene and acrylonitrile are under close scrutiny. In an adjacent field new tests

[1] F. H. H. Roberts, *Scientific Monthly*, 58: 156–157, 1944.

for adhesive properties and aging characteristics of tapes and for the rheological properties of elastomeric adhesives have been adopted as guides in the development of novel adhesive compositions. Extremely finely divided silicate minerals have been found satisfactory as reinforcing fillers for natural and synthetic rubbers.

Discoveries in Protective Coatings

The fellows in the domain of protective coatings have similarly shown ready and productive responsiveness to heavy demands. Investigations were continued on underwater coatings and several papers were published on the basic aspects of antifouling paint performance. Exhaustive studies of possible accelerated corrosion effects arising from the accidental or deliberate contacting of steel hulls by the antifouling paint have disclosed that appreciable acceleration can arise under the usual type of heavy metal-containing antifouling compositions. The interposition of even a single barrier paint coat substantially eliminates any accelerated attack, though all tests indicate the desirability of employing at least two such intermediate coats. Accidental contact with large areas of the hull not only causes accelerated pitting but also may inactivate the antifouling paint.

Some New Compounds and Their Uses

Descriptions were released of simple and differential cryometers for measuring the degree of purity and the freezing temperatures of liquid or melted substances. An article set forth information on foam formation in organic liquids. The production of alkylene polyamines is being delineated precisely for industrial application. New organo-silicon compounds have been prepared and made commercially. The likely industrial utility of new aluminum derivatives has been surveyed from all points of view. From investigations on nickel compounds and catalysts, products have been developed that are of promise in the synthesis of motor fuel, in the preparation of chemicals for synthetic rubber and as ingredients for lubricants, paints and combination insecticides-fungicides. In other insecticide research several difficult assignments have been dealt with. For instance, an insecticide has been originated which is being tested for use in an important war application. Then, too, the betterment of insect repellents is being carried forward.

Success in the Pharmaceutical and Chemical Hygiene Fields

Several new organic iodine compounds have been prepared in research relating to improved iodine antiseptics. A novel commercial synthesis of theophylline has been achieved. Work on intermediates for sulfa drugs has kept pace with current advances in the field. A new petrolatum gauze has been developed. Dehydration of gypsum to produce plaster for surgical casts has been accomplished by an improved process. The original paths of research of the Industrial Hygiene Foundation at the institute have become avenues of progress. In chemical hygiene by means of animal and human experiments there have been completed studies on the toxicity of several new products and of materials whose health hazards were unknown, all of them used by the military forces or by prime government contractors: dioctyl phthalate, new cable-impregnating compounds, low-temperature lubricants, extreme-pressure lubricants, newer insect repellents, a new textile lubricant and cobalt oxide dust. "Range-finding" toxicity tests have been performed on twenty-two new organic chemicals which are under industrial development owing to war demands. Altogether twenty-six of the hundred fellowships in operation relate to specific divisions of chemical technology.

The Institute's Department of Research in Pure Chemistry

The interests of this department have been directed chiefly toward studies on synthetic antimalarial drugs. The presence of U. S. Armed Forces in tropical areas (in which the hazards of climate and of endemic infections are foreign to conditions normal in most of our country) has given immediate pressure to the need for new chemotherapeutic agents for combating diseases which, in the past, were but occasionally found in our coastal cities and metropolitan centers, except in the southern states. Along with many other American laboratories, special emphasis has been placed on the synthesis of compounds which might prove of value in the treatment of malaria and of certain other infections previously rare within our own borders.

The Urgency of Research on Antimalarials

Even prior to our entry into the war, the need for new and more efficient therapeutic agents for coping with malaria was beginning to attract some share of the recognition to which this most important medical problem is entitled. The ability of this disease to influence the course of military campaigns, demonstrated again on many battlefronts of World War II, has brought into sharp focus our deficiencies regarding drugs capable of controlling the infection. It has been reported that 85 per cent. of the U. S. and Filipino troops on Bataan suffered from malaria, and that the

infection rate in the South Pacific has averaged nearly 50 per cent. It seems established that, until new compounds are discovered which can act as casual prophylactics or can effect a true sterilization of the disease, the war in the Pacific will continue to be fought against two enemies, the Japanese and malaria-carrying mosquitoes. The fact that research on antimalarials is more than merely a war problem is indicated by the number of publications which have appeared on the possibility of the importation of malaria into the United States at the termination of hostilities. Species of mosquitoes capable of transmitting malaria are to be found throughout the nation and the return to civilian life of men bearing chronic malaria infections may possibly be followed by the establishment of new endemic foci in sections now free from the disease. Furthermore, as the strains of the parasite introduced will in general be foreign to this country, little or no existing immunity will be found thereto. Obviously, in the face of such possibilities, the search for new and improved antimalarials will require continuation in the postwar period.

Advances in the Institute's Antimalarial Program

Owing to the extreme urgency of the problem of finding improved antimalarials to replace quinine, a drug which is now practically unobtainable since the acquisition by the Japanese of the Dutch East Indies, the activities of this department have been largely concentrated on the synthesis of new drugs of possible antimalarial value. Because of wartime limitations, it is not permissible to describe these investigations. It can be stated, however, that the results obtained with certain new drugs as antimalarial agents are sufficiently encouraging to warrant further researches. A survey article on the advances in antimalarials has been published. Under a scheme promoted by the National Research Council, arrangements have been made for evaluating the antimalarial effectivity of new drugs. Furthermore, the cooperation of those fellowships engaged in research in organic chemistry at the institute has been enlisted, so that likely compounds prepared by them may also be tested if desired. Over eighty new drugs have been submitted for antimalarial appraisal, embracing substances related to quinine, quinacrine and pamaquine; in addition, many quinoline, pyridine and aromatic derivatives have been prepared and studied. In part, efforts have been directed toward possible ways of diminishing the toxicity of chemical structures recognized as possessing antimalarial potentialities. Facilities have also been provided for testing new drugs for possible activity against trypanosome infections.

Every resource is being employed to expand the institute's area of opportunity and aid to our country at war. In this résumé it is shown that results of value have been effected by tapping the constructive power of the research staff, whose members are constantly being given channels for personal assistance through the cooperative procedures of the institution and the close contacts maintained with governmental agencies.

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SPECIAL ARTICLES

STUDIES ON THE GROWTH OF RATS RAISED ON CHOCOLATE MILK[1]

At the present time rather large quantities of chocolate products are included in the average American dietary. A considerable amount of the chocolate is consumed in chocolate milk or in products containing appreciable amounts of milk solids. In spite of the increasing utilization of chocolate in the diet, questions are still raised concerning its possible harmful effects. Mueller and Ritchie[2] found that rats fed mineralized whole milk containing 1 per cent. of cocoa grew as well as those receiving the mineralized milk alone. When fluid chocolate milk containing more than 1 per cent. of cocoa was fed *ad libitum* the rate of consumption decreased as the percentage of cocoa added increased. When cocoa was added to whole milk powder definite retardation of growth did not result until 4 per cent. of cocoa was used. The results reported in this paper as well as those given in later papers by Mueller and coworkers[3] have attracted considerable attention because deleterious effects were obtained with the higher levels of cocoa. It is, however, difficult to evaluate the results until consideration is given to the actual amount of cocoa used in commercial chocolate milks.

Since a uniform chocolate milk was being prepared daily by our Department of Dairy Industry[1] we were asked to study its nutritional value on animals. The

[1] Published with the approval of the Director of the Wisconsin Agricultural Experiment Station. We are indebted to Mr. Gideon Hadary for the continuous supply of these milks.

[2] W. S. Mueller and W. S. Ritchie, *Jour. Dairy Sci.*, 20: 359, 1937.

[3] W. S. Mueller, *Jour. Dairy Sci.*, 25: 221, 1942; L. D. Lipman and W. S. Mueller, *ibid.*, 24: 399, 1941; Faye Kinder, W. S. Mueller and Helen S. Mitchell, *ibid.*, 25: 401, 1942; W. S. Mueller and Marilyn R. Cooney, *ibid.*, 26: 951, 1943.

milk was made by using 86.3 parts of whole milk and 11.7 parts of a chocolate syrup having the following composition:

Glucose	18.0 per cent.
Sucrose	33.5 " "
Invert Syrup	11.0 " "
Water	28.2 " "
Cocoa	9.0 " "
Stabilizer	0.2 " "
Salt	0.1 " "

The final product, therefore, contained 1.05 per cent. of cocoa. Another chocolate milk was prepared in the same manner except that partially skimmed milk (1.5 per cent. fat) was used. Four groups of 21-day-old rats of the Sprague-Dawley strain, averaging 40 to 45 gm, were placed on experiment. One group received mineralized whole milk, a second mineralized whole chocolate milk, a third mineralized partially skimmed milk and a fourth mineralized partially skimmed chocolate milk. The average growth at the end of four weeks for each of these groups is given in Table 1.

TABLE 1

	No. of rats	Average weight in grams after four weeks on milk diets	
		Male	Female
Trial I			
Whole milk	12	172	141
Whole milk plus chocolate syrup	12	182	143
Partially skimmed milk	12	172	137
Partially skimmed milk plus chocolate syrup	12	173	148
Trial II			
Whole milk	6	164	126
Whole milk plus chocolate syrup	6	151	133

The data show that there is no inhibition of the growth of young rats when commercial chocolate milk containing 1 per cent. of cocoa is fed. It is interesting that in Trial I the growth obtained on chocolate milk diets was slightly better than on whole milk. However, in a second trial the males on whole milk grew a little better than those on the chocolate milk. None of the differences are significant. The animals on partially skimmed milk responded as well as those on whole milk. This was undoubtedly due to the fact that sufficient vitamin A was supplied even by the partially skimmed milk when it was consumed at such a high level. The fat supplied in the chocolate probably also aided in the utilization of galactose.

These rats as well as other groups were maintained on the above milks for 16 weeks without any significant difference in growth. When the rats were carried through reproduction normal young were produced in all cases but the mothers on chocolate milk had some difficulty in rearing their young. Further work is now under way to determine the exact cause of this difficulty.

Although man would never subsist on a diet containing only chocolate milk, these results appear to be of some significance since earlier work in our laboratory has shown that the growth response of rats on a mineralized milk is a critical measure of certain changes in the nutritive value of the milk.[4] While these results give no indication of reactions which may be encountered by individual human subjects, they do show that animals may be raised on a diet consisting solely of mineralized chocolate milk without any ill effect. It should also be pointed out that one per cent. of cocoa in liquid milk is equal to about 7 or 8 per cent. of cocoa on the dry basis.

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ANTIBODY RESPONSE IN MAN TO INJECTION OF THE SPECIFIC ANTIGEN OF TYPE V SHIGELLA PARADYSENTERIAE[1]

SEROLOGICALLY specific types of dysentery bacilli are frequently encountered in endemic and epidemic areas. The selection of suitable strains for use in vaccines is but one of the difficulties which arises in attempting to immunize human beings against bacillary dysentery. Furthermore, the inherent toxicity of the organisms themselves is reflected by serious local and general reactions which render the use of vaccines undesirable and often hazardous. It would seem desirable, therefore, to have at hand as a prophylactic agent a material of broad immunological specificity and devoid of many of the toxic elements of the cells themselves. With this in mind we have undertaken the isolation of the specific antigens of certain of the *Shigella paradysenteriae* and have injected human volunteers with one of these chemically purified materials.

Antigens from Gram-negative bacteria can be obtained by a variety of procedures. Thus Boivin and his collaborators[2] used trichloracetic acid for extracting the antigens from a number of different Gram-negative organisms. Topley *et al.*,[3] on the other hand,

[4] C. A. Elvehjem, E. B. Hart, H. C. Jackson and K. G. Weckel, *ibid.*, 17: 763, 1934.

[1] The work described in this paper was done under contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Rockefeller Institute for Medical Research.

[2] (a) A. Boivin and L. Mesrobeanu, *Rev. Immunol.*, 1: 553, 1935; 2: 113, 1936; 3: 319, 1937. (b) L. Mesrobeanu, "Les antigènes glucido-lipidiques des bactéries (Etude chimique et biologique)," Paris, Libraires de L'Académie de Médecine, 1936.

[3] W. W. C. Topley, H. Raistrick, J. Wilson, M. Stacey, S. W. Challinor and R. O. J. Clark, *Lancet*, 1: 252, 1937.

obtained both the H and O antigens from the typhoid bacillus by chemical fractionation of enzymatic digests of the organisms. Morgan and Partridge,[4] in their studies on the Shiga bacillus, obtained the specific antigen by extraction with diethylene glycol, and recently Morgan and Schütze[5] reported that this material has been used for the prophylactic inoculation of 12 human volunteers.

Shigella paradysenteriae Type V has been chosen for study because this organism gives rise in experimental animals to antisera which cross react broadly with other types of the Flexner group. The antigen is obtained from the cells[6] either by direct extraction with diethylene glycol or by the enzymatic degradation with trypsin of acetone-killed cells. In either case, subsequent separation from serologically inert bacterial products is accomplished by means of dialysis, precipitation of nucleic acid as a heavy metal salt followed by electrodialysis, and finally fractionation of the antigen from solution with acetone or alcohol. The material obtained by these procedures is a lipo-carbohydrate-protein complex which appears to be quite homogeneous when examined by electrophoresis. The antigen contains 4.5 per cent. nitrogen, 1.5 per cent. phosphorus and 15 per cent. phospholipid. On acid hydrolysis some 50 per cent. of reducing sugars are liberated, the antigen is broken down, and its immunological properties are destroyed. The protein-like moiety of the antigen is characterized by marked acetic properties and an unusually high tyrosine content.

The material isolated from Type V bacilli is a potent antigen which is highly toxic. Three injections of 50 micrograms given intravenously to rabbits evoke antibodies which agglutinate the homologous organisms in dilutions as high as 1:6400, and in lower dilutions agglutinate Types W, Y, Z and VZ microorganisms as well. Quantities as small as 0.5 mg invariably kill mice when injected intraperitoneally. Repeated attempts to detoxify the material without destroying its antigenic efficacy by a variety of chemical and enzymatic means have thus far been unsuccessful.

Despite the toxicity of the material, its unusual antigenic properties have enabled us to use sufficiently small doses for the production of antibodies in human beings without encountering untoward reactions. A group of 20 volunteers were injected intradermally with a total of 22.5 micrograms. The first dose of 2.5 micrograms was followed within a week by a second dose of 7.5 micrograms. The third and final dose of 12.5 micrograms was given one week later. There was little or no systemic reaction resulting from administration of these small amounts. The initial dose was in all instances followed by a local reaction which began 2-3 hours after the inoculation. The reaction consisted of swelling, redness and tenderness associated with transient lymphangitis and lymphadenopathy. The local reactions disappeared after 24–36 hours. Administration of the second dose of 7.5 and of the final one of 12.5 micrograms was unaccompanied by local or systemic reactions.

The volunteers were bled 2½ weeks following the last injection. The agglutination titer of these sera and of those collected before injection was determined. In all instances there was a marked increase in titer following inoculation, some sera agglutinating in dilutions as high as 1:800 to 1:600. These titers compare favorably with those obtained following the use of typhoid vaccine. Several antisera when tested against heterologous strains agglutinated microorganisms of Types W, Y, Z and VZ as well as those of the homologous type. The titers varied with the type and in all instances were higher than those of the pretreatment sera. That the antibodies evoked by the Type V antigen are not of a transitory nature is evidenced by the fact that the sera of several volunteers taken 6 months after injection showed no pronounced diminution in titer. When compared with the pooled pre-treatment serum, the post-treatment pooled serum showed a tenfold increase in mouse protective antibodies. A challenging dose of 1500–2000 M.L.D. of homologous Type V organisms required 0.20 cc of the former and only 0.02 cc of the latter serum to protect 50 per cent. of the animals. Furthermore, the post-treatment pooled serum showed a moderate increase in protective antibodies against virulent heterologous Type Z organisms.

A desirable agent for the prophylactic immunization of human beings against dysentery bacilli infections is one that is polyvalent and relatively non-toxic. The antigen prepared from Type V *Shigella paradysenteriae* gives rise in human beings to antibodies which are broadly cross reactive. The toxic properties of the antigen are, to be sure, undesirable, yet because of the small quantities necessary it can be used for human administration. Whether the injection of human beings with these specific antigens will afford protection against bacillary dysentery must, of course, await trials in the field.

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[4] (a) W. T. J. Morgan, *Biochem. Jour.*, 30: 909, 1936; 31: 2003, 1937. (b) W. T. J. Morgan and S. M. Partridge, *Biochem. Jour.*, 34: 169, 1940; 35: 1140, 1941.

[5] W. T. J. Morgan and H. Schütze, *Lancet*, 2: 284, 1943.

[6] We are indebted to Dr. W. A. Jamieson, of the Eli Lilly Company, Indianapolis, Indiana, for his generous cooperation in furnishing us with dysentery bacilli.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PARAFFIN "CONWAY UNIT" FOR THE DETERMINATION OF AMMONIA

IN 1933 Conway and Byrne[1] described an apparatus for the micro-determination of volatile substances such as ammonia. The unit consisted of a flat, cylindrical, glass cup with a lower concentric inner wall arising from the floor of the cup. Absorption of ammonia occurs from the outer chamber to the inner one, the entire cup having been sealed by a glass plate resting on the outer wall whose upper edge has been ground to a plane surface and smeared with vaseline. Borsook[2] modified this "Conway unit" by turning it out of lucite on a lathe and varying the dimensions to suit his electrometric determination.

Where a large number of these units are required the cost of having them made of glass, as described by Conway and Byrne, becomes excessive. Under present wartime conditions, the large lucite rods used for the manufacture of the modified form suggested by Borsook are unavailable. We attempted casting the units with acrylic resin (Trulite), the plastic used for dentures, but were unable to eliminate the inclusion of air bubbles with the molding facilities at hand. Turning to other substances we found that high melting paraffin (M. P. 55°–58° C) made highly satisfactory units. These were cast in a brass mold which was turned from a 3-inch piece of brass rod. The paraffin cups are very easily made and being inexpensive can be replaced when they become chipped, broken or discolored after long use. The material is inert to the reagents used for determining NH_3 or urea. Being white and translucent they offer an excellent background for end point titration of the indicator in the inner chamber.

The mold, Fig. 1, is cut on the lathe from a metal rod and the grooves for the walls of the unit are tapered with their bottoms somewhat rounded to facilitate the removal of the hardened cup. Loosely fitting rods fit in holes drilled through the mold as indicated in the diagram. A thin metal plate under the mold prevents these rods from falling through.

To make the cups the surfaces of the mold are first swabbed with mineral oil, then wiped clean with cleansing tissue. The liquefied paraffin is poured and as soon as the paraffin has hardened, the mold is placed in a refrigerator for about ten minutes. The hardened cup can then be easily released from the mold by tapping lightly on the rods. The upper edge of the outer wall of the unit is now ground to a plane surface by rubbing it on a flat paper-covered surface. A glass plate cover used during the period of distillation can then be securely sealed with glycerine, made alkaline to phenolphthalein.

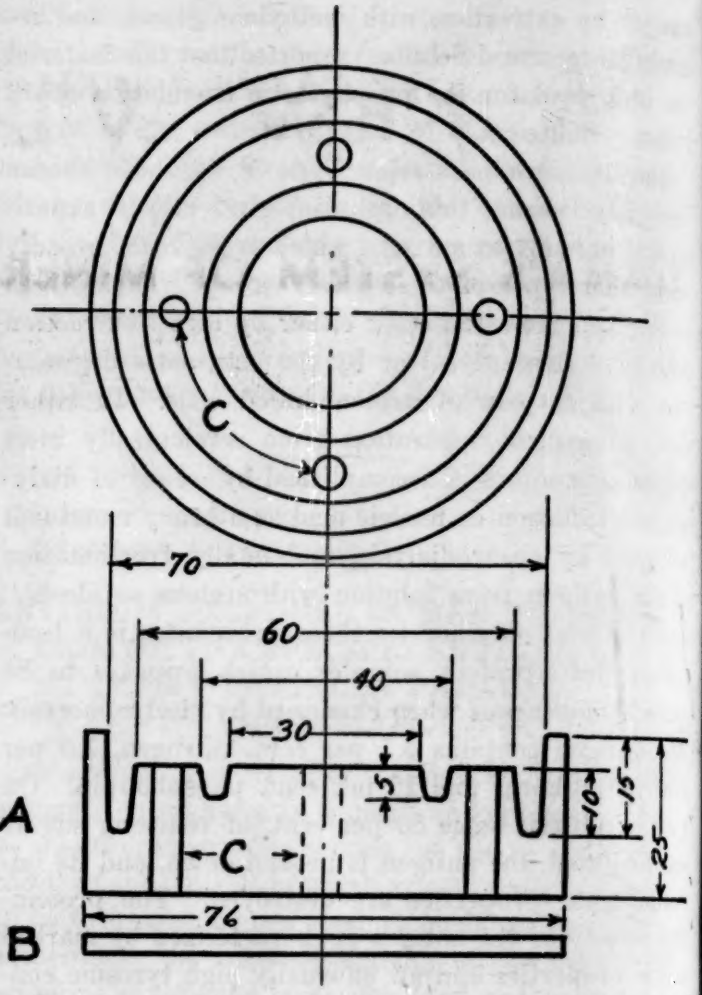

FIG. 1. A. Cross-section of mold. B. Circular metal plate for support of rods in holes C. Dimensions in millimeters.

We believe that paraffin may offer a satisfactory substitute for many other types of simple reaction vessels.

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